Influencing of Space Limitation on Critical Properties of Liquids

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The analysis of influencing of a system of space limitation on its critical properties is one of the problems of critical phenomena. Thin surface layers, transitional areas, porous medium, biomembrances, synoptic clefts can be examples of finite-size systems, research of which has both practical and theoretical interest.

The major problem of the statistical-physics approach to the theory of phased transitions in the finite-size systems is the problem to find the pair correlation function (CF) and corresponding correlation length of the order parameter fluctuations. The differential equation, obtained on the basis of a known integral Ornstein-Zernike equation, is used for finding the CF. The direct correlation function (DCF) entering into a differential equation for CF in a large number of works is presented as a delta-function. It is a gross approximation. We present the DCF as a Gaussian function which much better approximates the DCF than a delta-function.

The expression for the CF was obtained on the basis of solution of this differential equation for the system with cylindrical geometry. It is proven that CF demonstrates an oscillatory behavior in the z direction, i.e. along the cylinder radius that sharply differs from a case with infinite system, when the CF has an exponential shape.

On the basis of this CF the correlation length (CL) is calculated and its behavior is studied in different spatial directions. It is proven that the CL in the plane perpendicular to a cylinder axis in a critical state has a limited value, depending on the cylinderís radius. Along the cylinder axis the CL in its critical point is much more than in a perpendicular direction. It doesnít strive for infinity as in case with infinite systems.